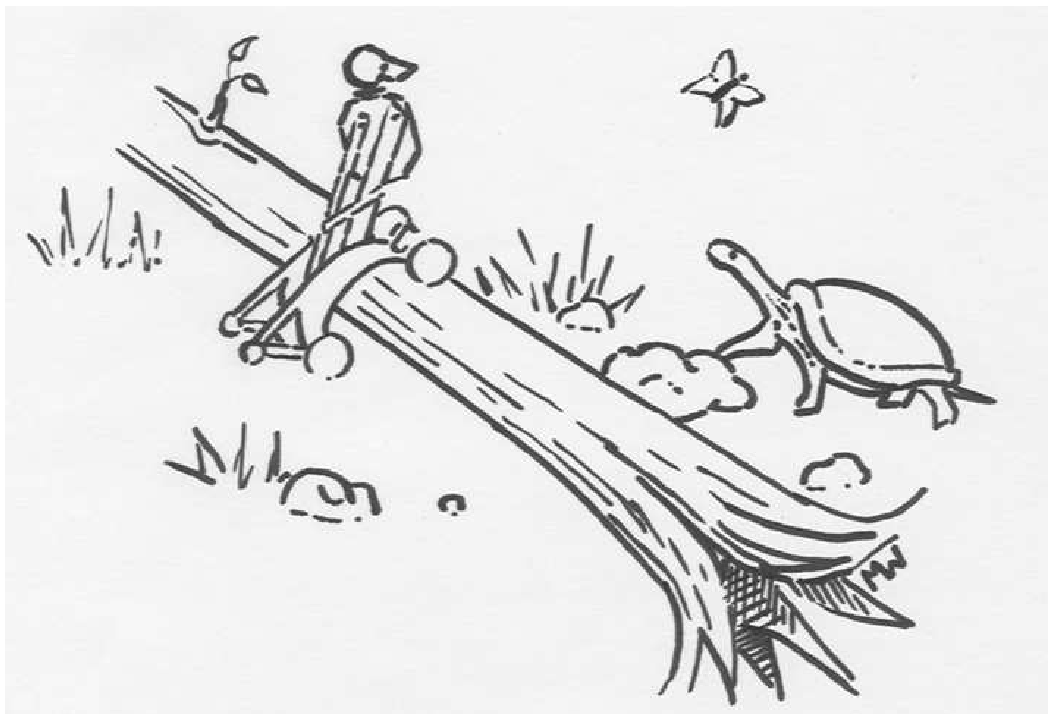
The Personal Rover Project



Illah Nourbakhsh

The Robotics Institute

My Personal Rover:
A Domestic, Educational Science Rover

Illah Nourbakhsh, Carnegie Mellon University

OBJECTIVES:

Introduce a low-cost mobile science rover platform, including necessary hardware and software innovations, enabling a user to design and execute science missions in the domestic environment and over the long term.

INNOVATIONS:

Low-overhead perception; back-EMF motor control; dynamic terrain stability; human-robot interaction design and formative evaluation cycle

MILESTONES:

- Year 1: Underlying technologies and first chassis
  - Vision and motor control boards
  - Temporary 802.11b + StrongARM architecture
  - Moving COM chassis hardware complete
- Year 2: Interaction design and first revisions
  - Back-EMF motor speed control
  - Server-side interface development
  - Mission-control demonstration, evaluation
- Year 3: High-level behavior and software finish
  - Final communication design & implementation
  - User community teaching and seeding
  - Self-docking and other autonomy behaviors

NASA RELEVANCE:

- Excite and inspire children regarding science and engineering
- Stimulated the public's understanding of the technologies that enable today's missions; I.e. Advanced Autonomy.
- Tie-in with outreach goals of MER
  - MER support of Personal Rover web community
  - Mars remote access via data links to Personal Rovers in homes and in Mars yards

Accomplishments

- CMUcam low-overhead vision system
  - paper presentation at CVPR and now at IROS ‘02
  - DSP version at the frame dump level
- Rover prototype R1
  - interaction design and GUI study
  - hardware (3x), motor control systems, 802.11b firmware
  - four-encoder position integration algorithm
  - GUI’s: teleoperation, teaching and mission scheduling
  - AAAI demonstration and workshop paper
- Rover prototype R2
  - low-cost hardware x 35 copies
  - Back-EMF speed control and terrain sensing
- *Robotic Autonomy* summer course
  - community experiment, longitudinal educational study

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Low-overhead perception; back-EMF motor control; dynamic terrain stability; human-robot interaction design and formative evaluation cycle

MILESTONES:

- Year 2: Interaction design and first revisions
  - User notification development-- niche building
  - Mission-development user testing
  - Rover & interface re-design
  - Longitudinal educational study
  - 802.11 driver board; IP2020control board
  - Scheduler and executive: multi-day implementation
- Year 3: High-level behavior and software rollout
  - Final communication design & implementation
  - User community teaching and seeding
  - Self-docking and other autonomy behaviors

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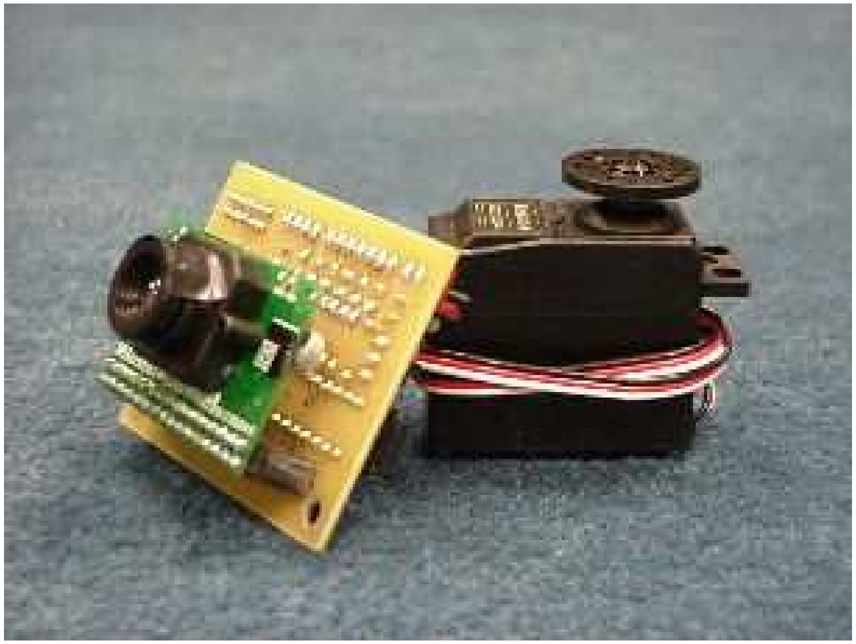
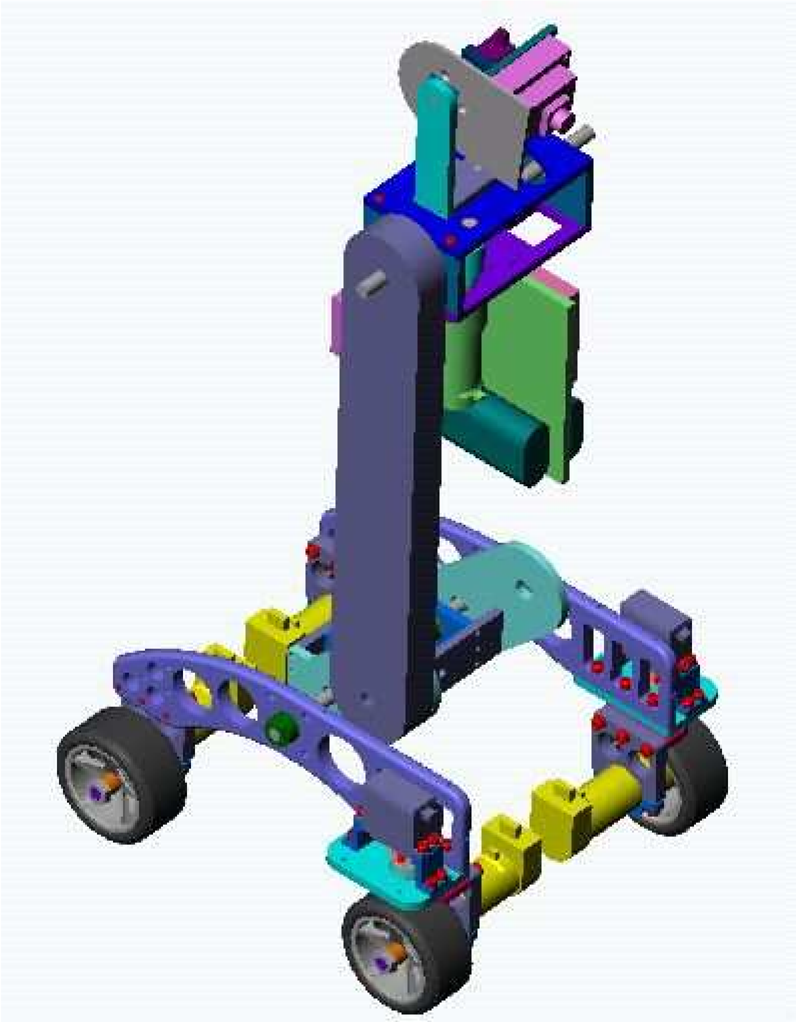
CMUcam: low-overhead perception

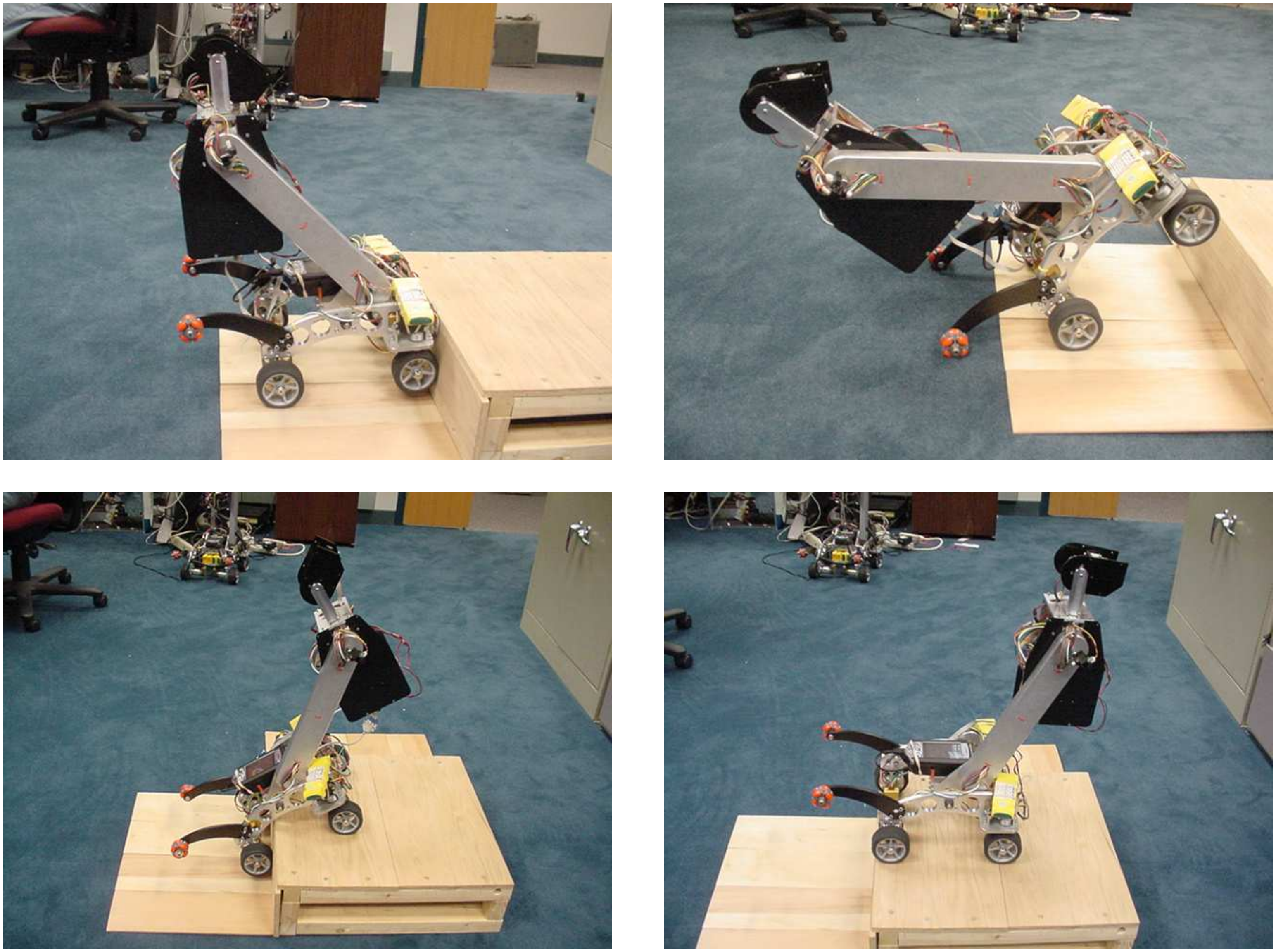


- User community exceeds 300 individuals, four universities
- Next: histogram-based obstacle avoidance and navigation; image differencing

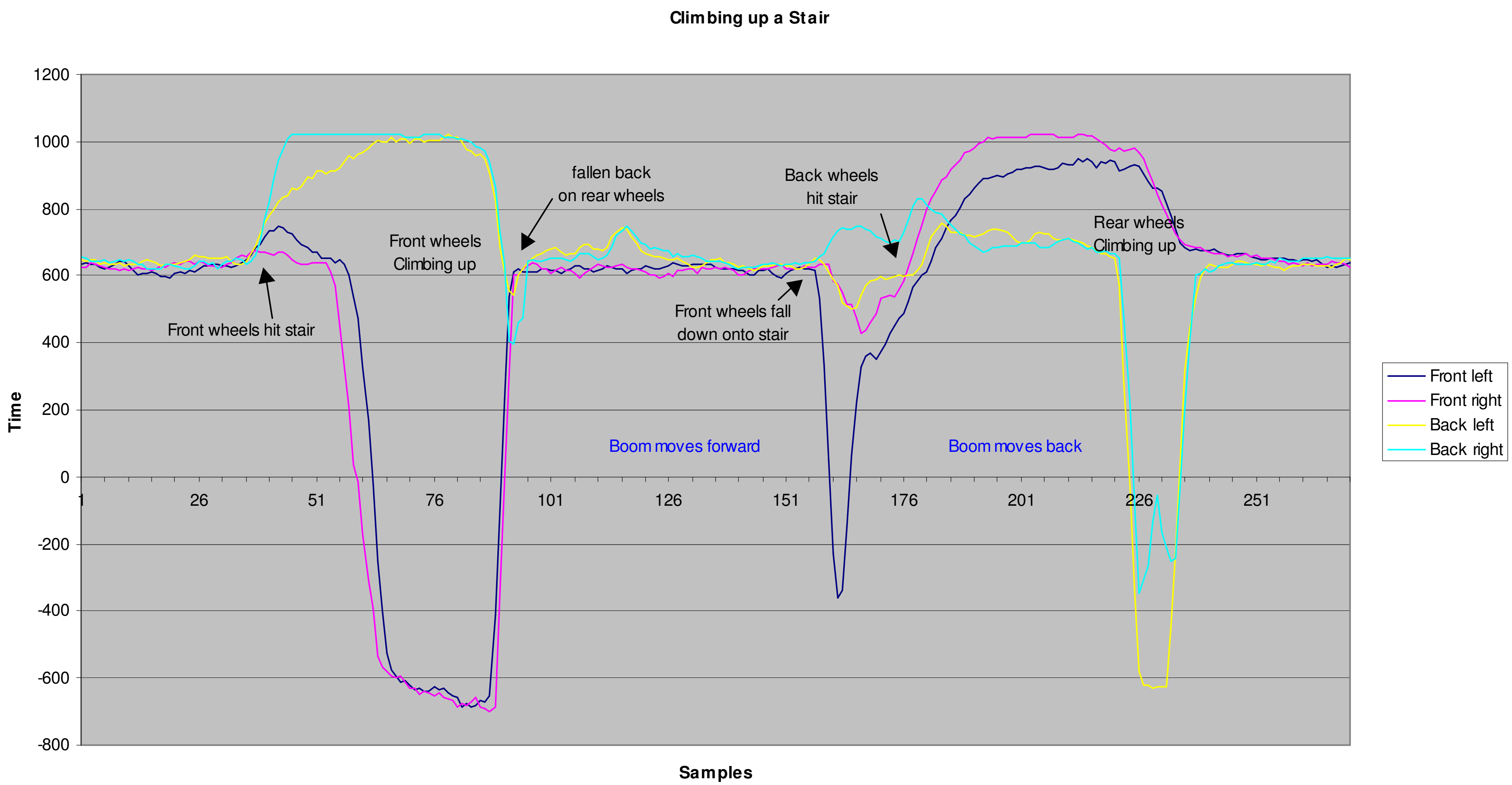
Rover prototype design



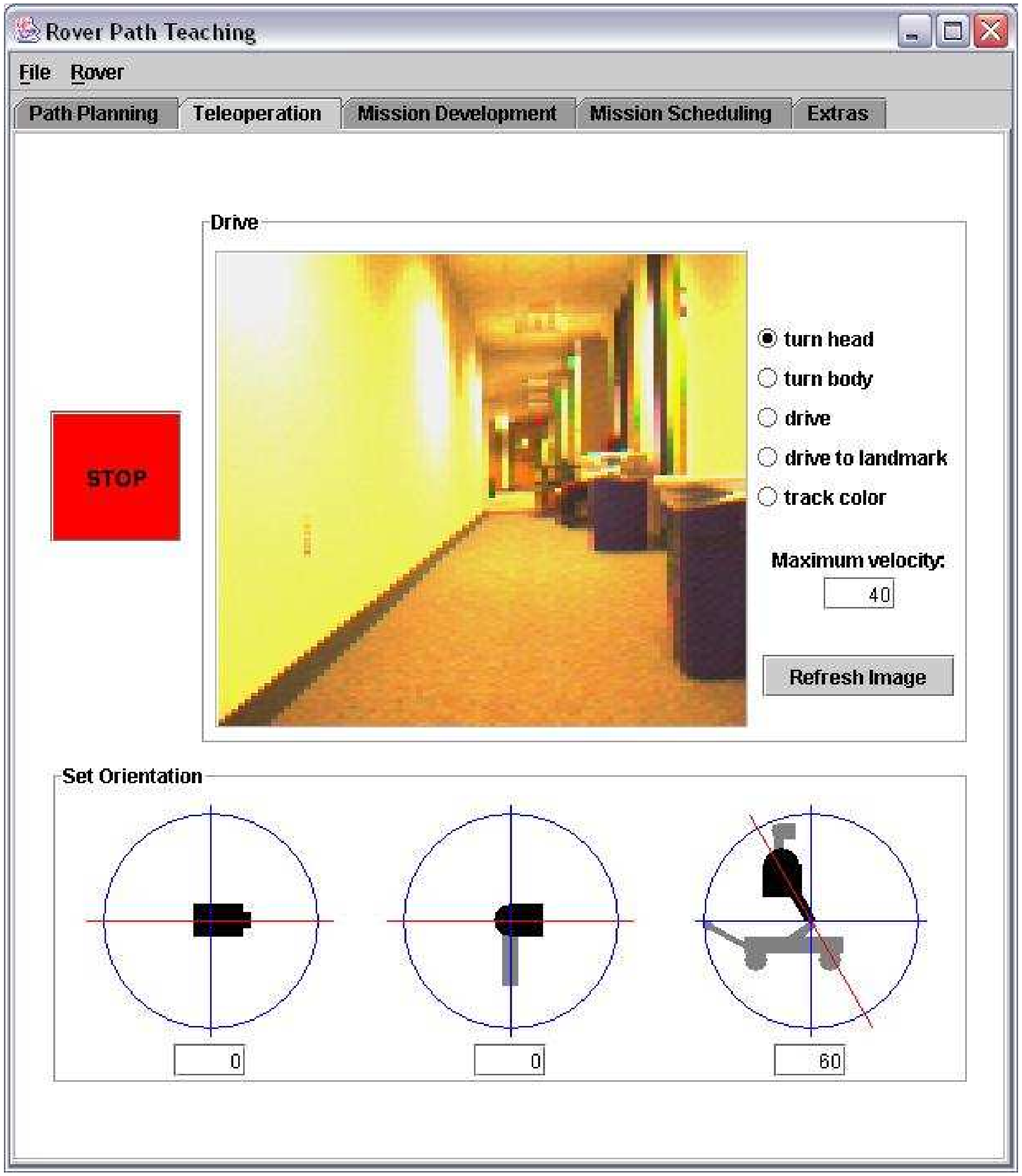
Current-based terrain sensing and COM shift



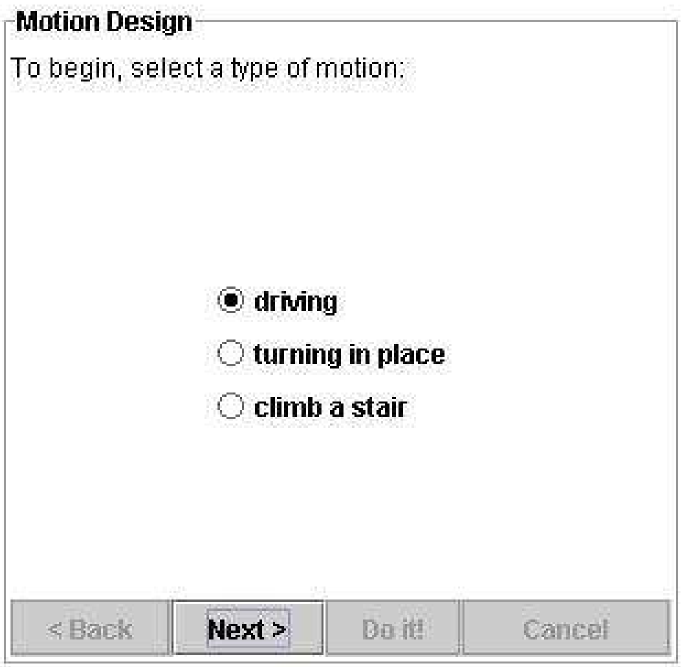
Back-EMF trajectories during stair climb



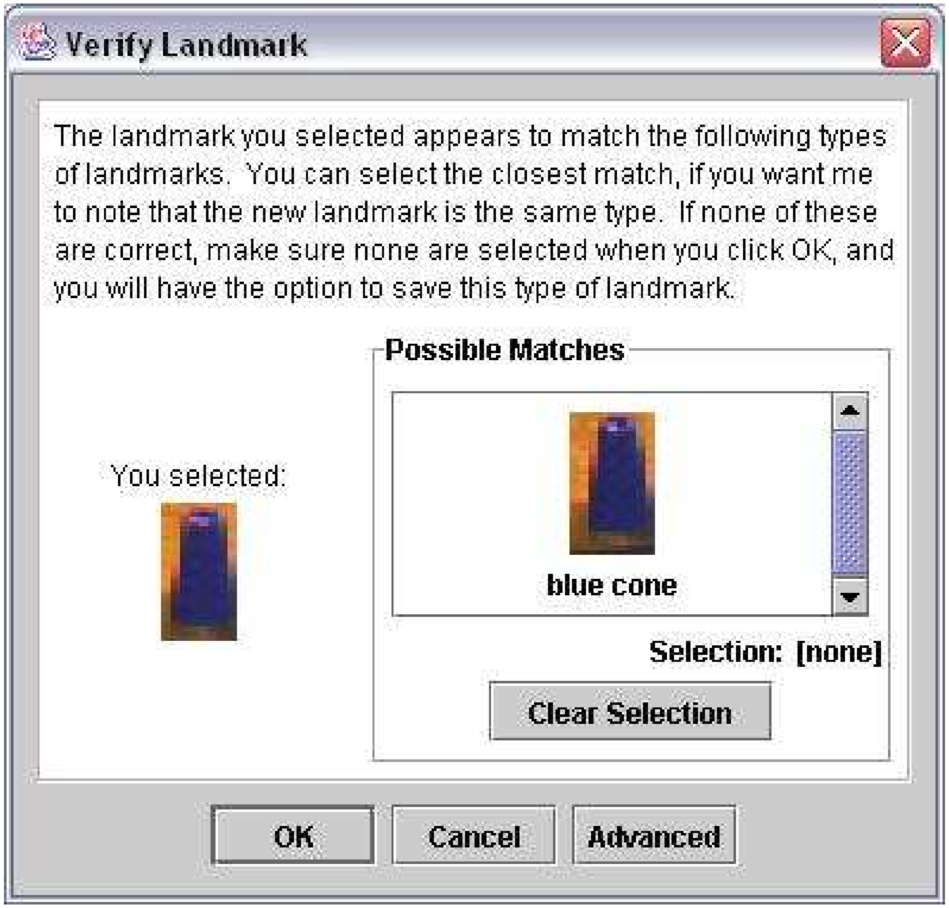
Teleoperation & Teaching Interface



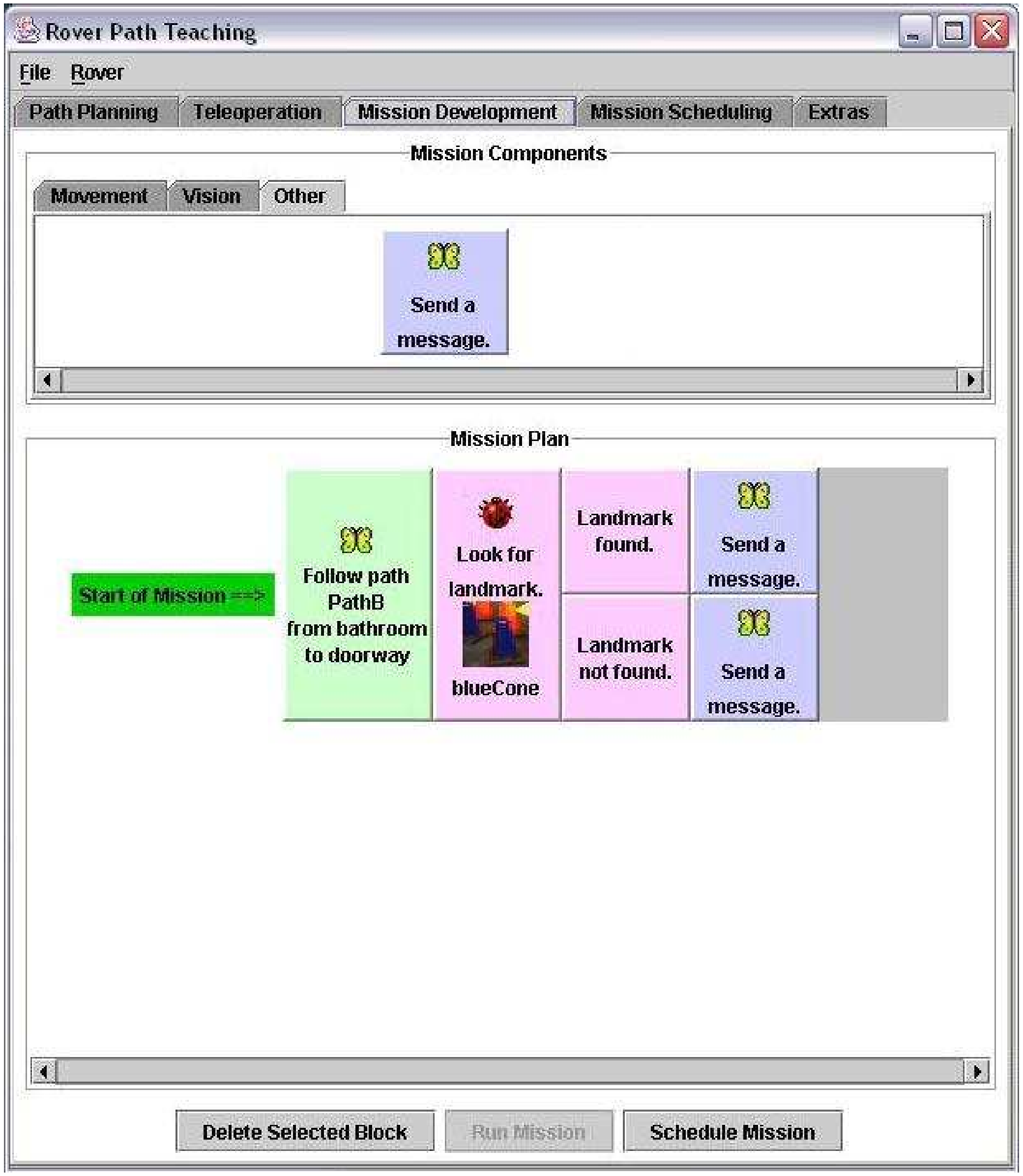
Teaching Wizard Flow



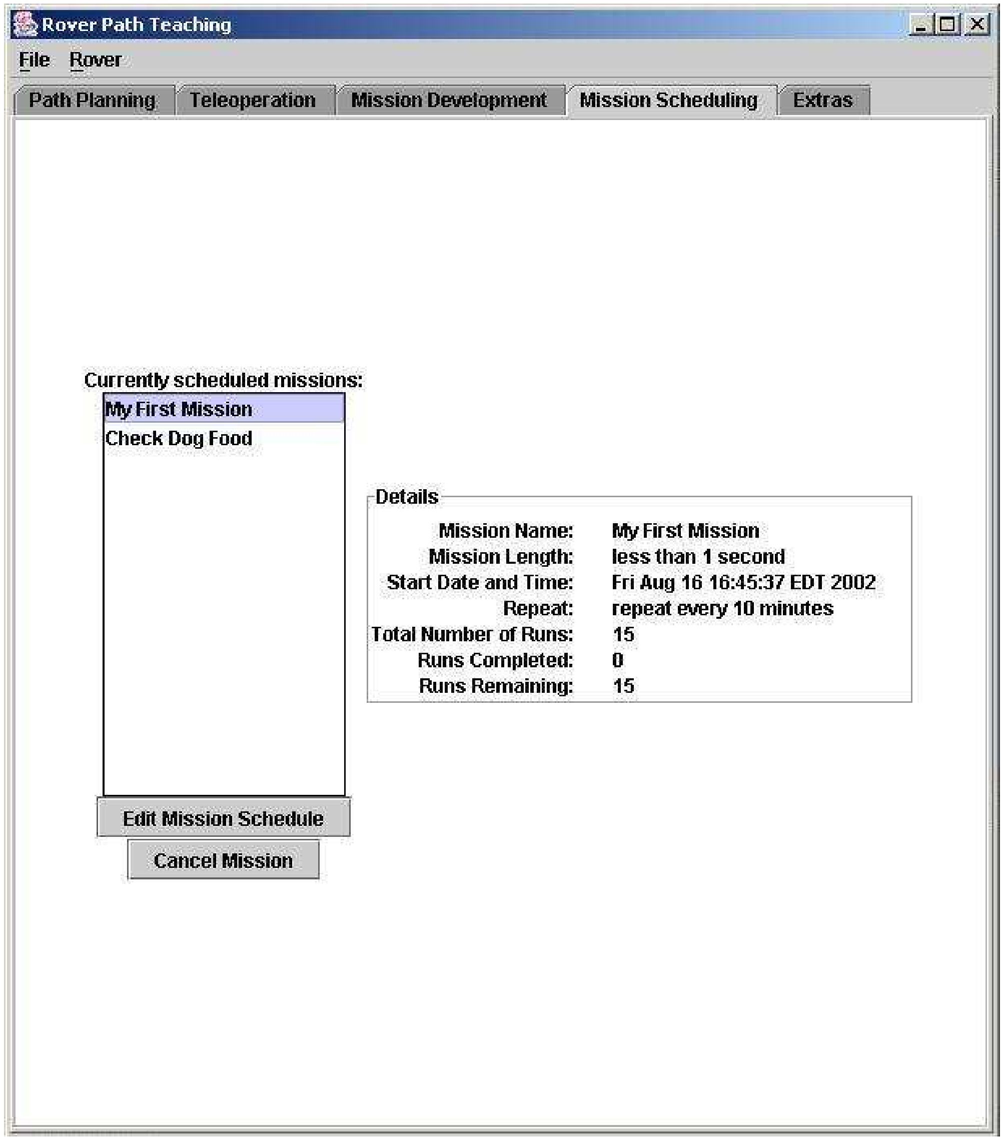
Teaching Wizard Flow (2)



Long-term Mission Development Interface



Mission Scheduling



Robotic Autonomy: RI 16-162U

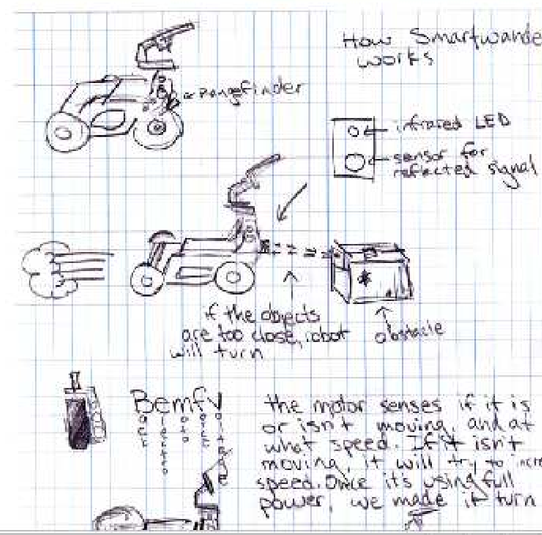
Course Website: www.cs.cmu.edu/~rasc

Robotic Autonomy - Microsoft Internet Explorer

Address: http://robotauto.west.cmu.edu/RA/DuctTape/Duckt_Wk3.htm

Smart Wander

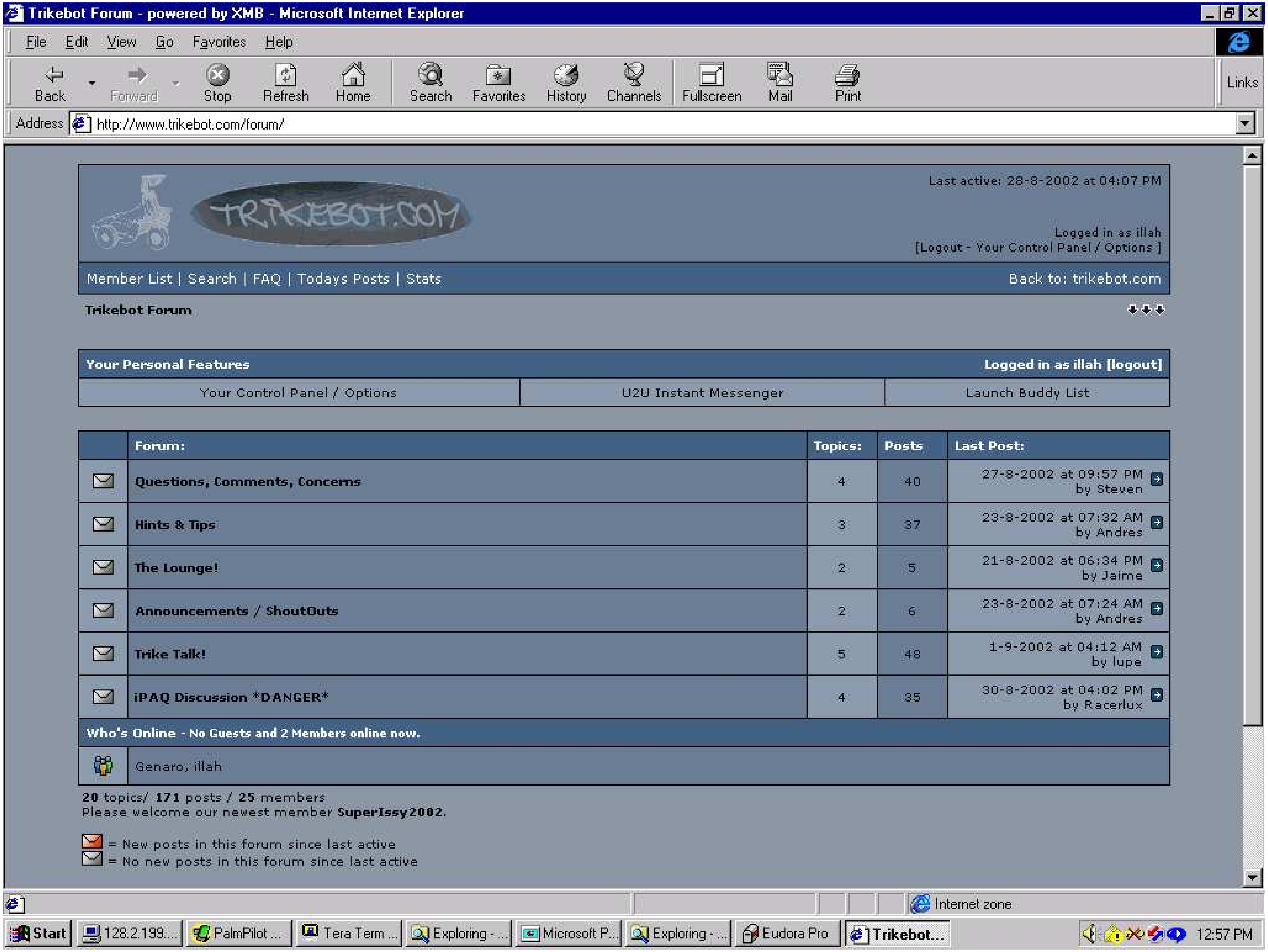
Summary: Wanderbot is a very basic autonomous movement program for trikebots. Its principal function, smart wandering, enables it to move continuously in most areas. It uses a rangefinder to identify any object that gets close to the robot (or at least the sensor) and once it recognizes this, it backs up, and then turns itself if a new direction. This can be any number of degrees, but we chose for ours to rotate 135?, at least initially. After turning, the robot continues its journey. Also, because of the back EMF properties of the trikebot's motor, the trikebot will also turn around if it becomes stuck on anything, even if it cannot be found in the rangefinder. This combination of abilities should enable it to get around virtually every obstacle on flat ground.



Directions: Wanderbot is pretty much an autonomous robot that moves, acts smart, and feels; with the touch of one button. Wanderbot starts moving forward at (30,0) until it reaches a certain distance from an object (–25000), then it backs up (-10,0) and then turns 115 degrees and continues traveling at (30,0).

On the other hand if it gets stuck on any part of the robot and is unable to move forward for ½ a second it automatically backs up (-10,0) and turns 90 degrees then continues to move forward.

Performance: After getting Wanderbot to work the testing took place on many different environments, it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Address http://www.trikebot.com/forum/

TRIKEBOT.COM

Last active: 28-8-2002 at 04:07 PM

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Forum:	Topics:	Posts	Last Post:
Questions, Comments, Concerns	4	40	27-8-2002 at 09:57 PM by Steven
Hints & Tips	3	37	23-8-2002 at 07:32 AM by Andres
The Lounge!	2	5	21-8-2002 at 06:34 PM by Jaime
Announcements / ShoutOuts	2	6	23-8-2002 at 07:24 AM by Andres
Trike Talk!	5	48	1-9-2002 at 04:12 AM by lupe
iPAQ Discussion *DANGER*	4	35	30-8-2002 at 04:02 PM by Racerlux

Who's Online - No Guests and 2 Members online now.

Genaro, illah

20 topics/ **171** posts / **25** members
Please welcome our newest member **SuperIssy2002**.

= New posts in this forum since last active
= No new posts in this forum since last active

Internet zone

Start 128.2.199... PalmPilot ... Tera Term ... Exploring - ... Microsoft P... Exploring - ... Eudora Pro Trikebot... 12:57 PM

Registered: 18-8-2002
Member Is Offline

Mood:

PROFILE EMAIL FIND U2U

Miguel
Newbie

Posts 2
Registered: 19-8-2002
Member Is Offline

Mood:

posted on 20-8-2002 at 04:23 AM

EDIT QUOTE REPORT

i don't know if the speed of the trikebot would be sufficient to get the ball fast enough and also the tracking is as we have seen before is not very accurate in distances longer than 15 feet under the sun however if we take into account that the balls usually stop near the net you could just hjave the robot scan those particular areas and sweep them between sets even if it doesn't detect anything

i don't know but it might work

PROFILE EMAIL FIND U2U

David
Junior Member

Posts 26
Registered: 18-8-2002
Member Is Offline

Mood:

posted on 20-8-2002 at 04:34 AM

EDIT QUOTE REPORT

with all the processes the trikebot has to go through, the time it takes for the trikebot to respond and then get off the court might be excessive. As for trikebot speed, if it is calibrated in the calibration window to go full 127 forward and -127 reverse, the full speed is significantly improved. As for recognizing the balls, I agree that ActiveColorTracking is not the best thing to use. What the robot would likely do is scan for the area where the tennis ball is using GetMean and comparing values and then either dead reckon to that location or execute a more specific color tracking routine from the iPaq which could afford to be much more sensitive.

PROFILE EMAIL FIND U2U

Jaime
Ding Dong

Posts 43
Registered: 18-8-2002
Member Is Offline

Mood:

posted on 20-8-2002 at 04:47 AM

EDIT QUOTE REPORT

Since we want to use the trikebot instead of another robot...

What if you just add a lightweight but strong arm that extends the length of half a court and just have some pnuematic pumps that extend the arm the full width of the court. This way, with just two trikebots, you can instantly clear the entire court, although you would need some more robots to actually pick up the balls, unless you use a vacuum hose of some sorth on the long arm to actually suck up the balls.

PROFILE FIND U2U